MIDDLE PALAEOZOIC BRACHIOPODS AND CORALS FROM KASHMIR

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(Plates VIII and IX)

[Read 26th July, 1967]

Synopsis

Two rugose and three tabulate coral species are described from the Naubug Beds of Upper Silurian age east of Islamabad (Anantnag), Kashmir, and nine brachiopod species and a rugose coral from the Muth Quartzite of the same area. This latter fauna is considered to indicate a Lower or lower Middle Devonian age.

INTRODUCTION

East of Islamabad (Anantnag), Kashmir, a succession of Ordovician and older deposits occupies the core of a broad gently north-west plunging anticline. It is conformably overlain by the Silurian succession, comprising shales, the Harpatnar Beds and the Naubug Beds. The Harpatnar Beds consist of buff-coloured graptolitic shales, and the Naubug Beds, blue grey to rusty calcareous sandy shales. Monograptids have recently been collected from the Harpatnar Beds, and suggest a Lower-Middle Ludlow age (Berry and Gupta, 1966). A large fauna of brachiopods, trilobites and nautiloids have been reported from the Naubug Beds by Reed (1912). A few corals have recently been collected from the uppermost part of the Naubug Beds of this area (Fig. 1), and are described in the palaeontological part of this paper. They include the following species: *Stewartophyllum* sp., *? Stereolasma* sp., *? Heliolites* sp., *Favosites gothlandicus* Lamarck forma *forbesi* Milne-Edwards & Haime and *Favosites* sp.

The Naubug Beds are succeeded, apparently conformably, by the Muth Quartzite. Devonian fish remains—probably an osteolepid and a dipterid—have been obtained from dark calcareous shales situated at the base of the Muth Quartzite south-west of Margan Pass (Gupta and Denison, 1966). Devonian fish material is most commonly found in non-marine Old Red Sandstone deposits, usually lacustrine or fluviatile in origin. However, they have occasionally been found in marine sediments—for example, in the Middle Devonian limestones of Taemas in New South Wales and Buchan in Victoria (Hills, 1958). The fish remains suggest a Lower or Middle Devonian age for the base of the Muth Quartzite. According to Middlemiss (1910, p. 217), a thickness of 3,000 feet of Muth Quartzite is developed in Kashmir.

Brachiopods, a trilobite, *Phacops rana* Green, a gastropod, *Diaphorostoma* sp., and a lamellibranch, *Modiomorpha* sp., have also recently been identified from a locality near Naubug situated stratigraphically towards the middle of the Muth Quartzite (Sahni and Gupta, 1964). The locality is one mile north of the village of Naubug (33° 40′ 30″ N.; 75° 23′ 30″ E.). The brachiopods, and also a solitary rugose coral, from this locality (Fig. 1) are described in the palaeontological part of this paper. The coral and brachiopod fauna is as follows: *? Stereolasma* sp., *Schizophoria* cf. *striatula* (Schlotheim), *Salopina* sp., *? Rhipidomella* sp., ? Davidsoniacea gen. indet., *Machaeraria* sp., *Plectatrypa* sp., *? Meristina* sp., *Athyris* aff. *spiriferoides* (Eaton), *Athyris* sp. and *Cyrtina* aff. *heteroclita*

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(Defrance). The fauna seems to have a definite Devonian aspect, possibly representing a lower Middle or Lower Devonian horizon. The presence of *Schizophoria* cf. *striatula*, *Athyris* aff. *spiriferoides* and *Cyrtina* aff. *heteroclita* support a Middle Devonian horizon, and *Plectatrypa*, *Salopina* and *Machaeraria*, a Lower Devonian horizon. *Calceola sandalina* has, more recently, been found by one of us (V. J. G.) from another locality in the Muth Quartzite of this area, and tends to confirm an upper Lower Devonian or a lower Middle Devonian age. The Muth Quartzite in this area exhibits both an apparently conformable relationship with the overlying Syringothyris Limestone (Lower Carboniferous), and an unconformable relationship with the Panjal Volcanic Series of Upper Carboniferous age (Pascoe, 1959, p. 637).

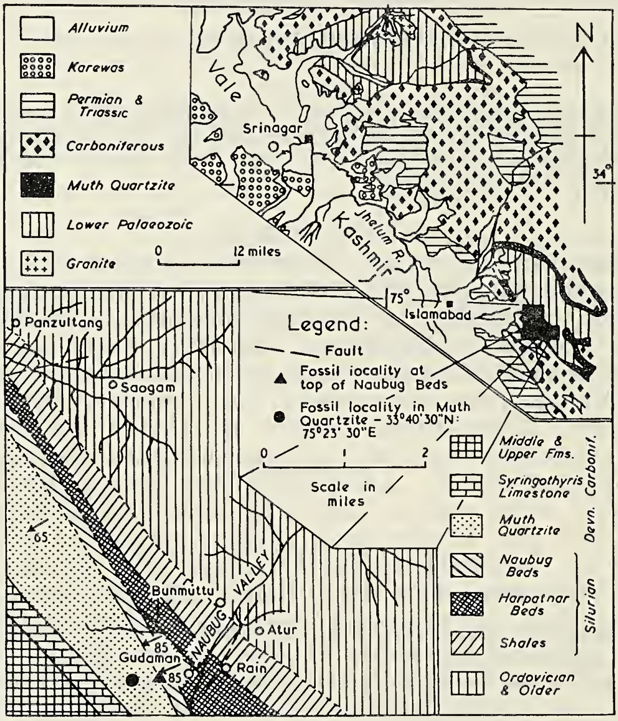

Fig. 1.—Detailed geological map of the Naubug valley area, showing the position of the fossi localities in the Naubug Beds and the Muth Quartzite. Inset map shows the generalized geology of the Vale of Kashmir and the location of the Naubug valley area, east of Islamabad (Anantnag).

Systematic Palaeontology

Numbers of specimens catalogued in the Museum of the Geology Department, Panjab University, Chandigarh, are prefixed PUGD.

Phylum COELENTERATA

Order Rugosa

Family Metriophyllidae

Genus *Stewartophyllum* Busch

Stewartophyllum sp.

(Plate 1, figs 1-2)

Material : One corallum (PUGD 1250). From the Naubug Beds locality.

Description : Corallum simple, small, trochoid, gently curved ; height 19 mm., attaining a maximum diameter of 12 mm. Exterior exhibits faint annulations and septal grooves. Calice moderately deep, at least 5 mm., with

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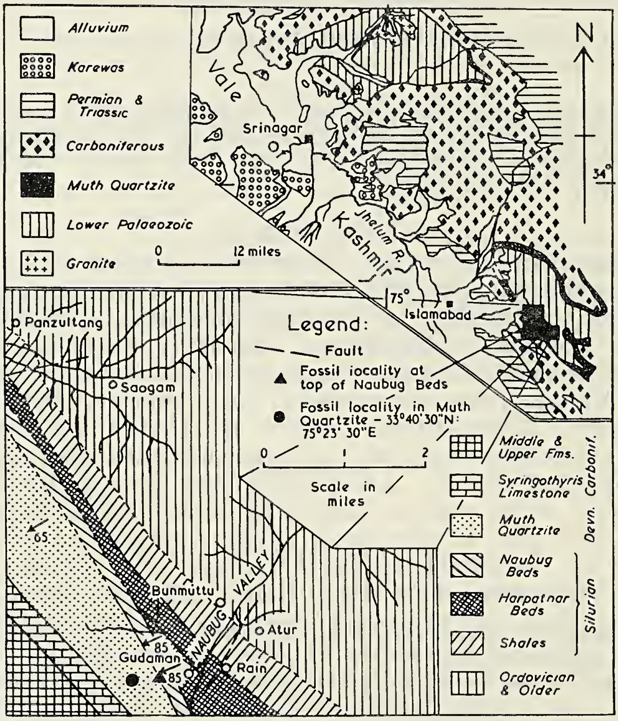

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Remarks: The coral bears the closest comparison with the Middle Devonian genus *Stewartophyllum. S. intermittens* (Hall) has more dilated septa and lacks an axial structure in early growth stages (Busch, 1941), and *S. polonicum* (Sobelev) is smaller, and the septa tend to be rhopaloid (Fedorowski, 1965). It may also be compared with the Upper Silurian genus *Duncanella*, but differs in having well developed cardinal and alar fossulae, being larger with more septa, and apparently lacking the flanged septa (Sutherland, 1965). It shows quite remarkably close similarities to the Lower Carboniferous genus *Zaphrentites*.

Another specimen (PUGD 1278) from the Naubug Beds is even more doubtfully assigned to *Stewartophyllum*. It is a silicified coral with a simple, small, slightly curved form, 16 mm. in height and having a greatest diameter of 10 mm. The exterior shows a few widely spaced annulations, and the calice is moderately deep with steeply inclined sides. The septa exhibit vague structures resembling carinae near the periphery, or they may represent septal flanges, such as those observed by Sutherland (1965, p. 41) in *Duncanella pontotocensis*. Minor septa also occur in this specimen.

Genus *Stereolasma* Simpson

? STEREOLASMA sp.

(Plate 1, figs 3-4)

Material: Five coralla preserved as internal moulds, two of which also exhibit parts of their external moulds. From the Naubug Beds (PUGD 1251-54) and the Muth Quartzite (PUGD 1255) localities.

Description: Corallum solitary, very slightly curved, trochoid. Height of 11 mm. and greatest diameter of 9 mm. is attained in specimen PUGD 1251. Another specimen has a greatest diameter of 15 mm. and a least diameter of 10 mm. (average of 12.5 mm.). Exterior exhibits septal grooves. Calice deep. Short major and minor septa in the upper two-thirds of the corallum; major septa seem to reach the axis in the lower one-third; 24-27 major septa. Structures seen in the internal moulds linking septa probably represent tabulae.

Remarks: An axial structure is not preserved, but may have been developed near the apex. The specimens seem to bear the closest similarities to *Stereolasma gallicalar* (Davis) from the Middle Devonian of Ohio (Stumm, p. 14), but differ in being shorter (more obviously trochoid) and having shorter septa.

Order TABULATA

Family HELIOLITIDAE

Genus *Heliolites* Dana

? HELIOLITES sp.

(Plate 1, figs 5-7)

Material: Part of a compound corallum, exhibiting the external mould of part of the calicular surface. Preserved in recrystallized dark grey limestone. From the Naubug Beds (PUGD 1256).

Description: Tabularia have average diameters of 1 mm. and are from 0·5 to 2 mm. apart (with 4-8 rows of tubuli between). Walls of the tabularia not clearly differentiated in thin sections. In oblique lighting of the transverse section, 12 radiating elements (septa) can be seen. The calicular surface shows the sunken tabularia with the frequent occurrence of a raised columella surrounded by the elevated coenenchymal tissues (reticulum). The reticulum consists of tubuli, variable in size and many-sided; outgrowths resembling carinae are developed where a tubulus is at the point of dividing. In longitudinal section steeply inclined sides. Corallum wall 1 mm. thick. Septa of one order, dilated towards the periphery; united to form an axial structure in the neanic stage and withdrawing from the axis in the adult (ephebic) stage; up to 23 septa. Cardinal fossula on the concave side; alar fossulae also well developed. Tabulae not observed.

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Remarks : The coral is doubtfully assigned to *Heliolites*, because of the lack of well-defined walls and the inward curvature of the tubuli towards the tabularia. It may in fact represent a new heliolitid genus characterized by the frequent division and inward curvature of the tubuli. Heliolitids are not known later than the Givetian (Jones and Hill, 1940, p. 186).

Family FAVOSITIDAE

Genus *Favosites* Lamarck

FAVOSITES GOTHLANDICUS Lamarck forma FORBESI Milne-Edwards & Haime

(Plate 1, figs 8-9)

Material : A small hemispherical colony measuring 13 mm. in diameter. From the Naubug Beds (PUGD 1257).

Description : Polygonal corallites of variable size, attaining a diameter of 1·8 mm.; walls of intermediate thickness. A few septal spines and mural pores observed. Tabulae flat to concave, six every 4 mm.

Remarks : This small specimen seems to be most closely comparable to the Silurian form *Favosites gothlandicus* forma *forbesi* (see Hill and Jones, 1940, p. 193). It is also quite similar to the Devonian form *F. goldfussi* d'Orbigny forma *pyriformis* Lecompte, showing a somewhat thicker wall structure and a closer spacing of tabulae (see Lecompte, 1939).

FAVOSITES sp.

Material : Portion of a poorly preserved, weathered colony measuring 6 cm. across. From the Naubug Beds (PUGD 1258).

Description : Polygonal corallites reaching a diameter of 2·2 mm. Impressions of tabulae faintly shown.

Remarks : This coral may also belong to the *F. gothlandicus* group.

Phylum BRACHIOPODA

Order ORTHIDA

Superfamily ENTELETACEA

Family ENTELETIDAE

Subfamily SCHIZOPHORIINAE

Genus *Schizophoria* King

SCHIZOPHORIA cf. STRIATULA (Schlotheim)

(Plate 1, figs 10-12)

Material : A single specimen preserved as an external mould. From the Muth Quartzite locality (PUGD 1264).

Description : Brachial valve convex, pedicle valve resupinate ; narrow dorsal fold and ventral sulcus. Outline subcircular to transversely elongated ; greatest width of shell 30 mm., measured midway from hinge line to anterior commissure ; anterior commissure uniplicate ; length of valve 25 mm. and hinge line measures 15 mm. Numerous fine costellae which are crossed by faint concentric growth lines.

Remarks : Apart from exhibiting a more acute and more narrowly uniplicate anterior commissure, the specimen agrees closely with Biernat's (1959) description of the exterior of *Schizophoria striatula.* Biernat considered the species to have a widespread distribution in the Devonian of Europe, Asia, North America and Australia, whereas Struve (1965) restricted *S. striatula* to the Frasnian of Germany. Specimens labelled " Schizophoria striatula " from the Hackberry Beds (Upper Devonian) of Iowa in the University of Sydney Geology Department reference collection (USGD 1485) are very similar in external form to the Kashmir tubuli exhibit a tendency to arch inwards towards the tabularia. Sola closely and evenly spaced.

Remarks : The coral is doubtfully assigned to *Heliolites*, because of the lack of well-defined walls and the inward curvature of the tubuli towards the tabularia. It may in fact represent a new heliolitid genus characterized by the frequent division and inward curvature of the tubuli. Heliolitids are not known later than the Givetian (Jones and Hill, 1940, p. 186).

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Genus *Salopina* Boucot

SALOPINA sp.

(Plate 1, figs 13-16)

Material : Five samples from the Muth Quartzite (PUGD 1259-63) containing disarticulated internal moulds of both valves.

Description : Outline from transversely elongated to subcircular; ventribiconvex; hinge-line straight, greatest width posterior to the middle; numerous fine unequal costellae; weakly developed sulcus in brachial valve.

Impressions of prominent slightly diverging dental plates in the pedicle interior; muscle field is not preserved. Simple, divergent brachiophores and dental sockets with faint impressions of fulcral plates in brachial interior, together with small, subrounded (tear-drop shaped) cardinal process.

Measurements : (in millimetres)

	Width	Length
PUGD 1259 (pedicle valve)	18	13
,, 1260 ,, ,,	14·5	13
,, 1261 ,, ,,	14	18 (possibly distorted)
,, 1262 (brachial valve)	17	12

Estimated thickness of adult shell (both valves) = 7 mm.

Remarks : This morphologically simple orthid is assigned to *Salopina*, a genus which ranges from the Upper Silurian to the Lower Devonian. It cannot be determined specifically, because details of the muscle impressions are not preserved. However, it seems to be close to *S. lunata* (J. de C. Sowerby), as recently described by Walmsley (1965), but has a somewhat larger shell and coarser costellae. It may be distinguished from *Isorthis* with its median ridge in the pedicle valve and more prominent cardinalia in the brachial valve (Walmsley, 1965), from *Sphenophragmus* with its proportionally shorter hinge line and more strongly divergent dental plates (Imbrie, 1959), and from *Mendacella* with its thick brachiophores and convex brachial valve (Boucot, Johnson and Walmsley, 1965).

Family RHIPIDOMELLIDAE

Genus *Rhipidomella* Oehlert

? RHIPIDOMELLA sp.

(Plate 2, figs 1-2)

Material : One poorly preserved internal mould from the Muth Quartzite locality (PUGD 1265).

Description : Subcircular, planoconvex; 11 mm. wide; short dental plates in pedicle valve and short, divergent brachiophores in brachial valve.

Remarks : The specimen seems to be a rhipidomellid, but it is too poorly and incompletely preserved for more positive assignment.

Order STROPHOMENIDA

Suborder STROPHOMENIDINA

Superfamily DAVIDSONIACEA King

? DAVIDSONIACEA gen. indet.

(Plate 2, figs 3-4)

Material : Two samples from the Muth Quartzite, exhibiting part of the internal mould of the brachial valve (PUGD 1266) and the exterior mould of another (probably the brachial) valve (PUGD 1267).

Description : Gently convex shell, finely costellate with dichotomous branching; length of shell 28 mm. and width 27 mm. measured along the hinge line. Brachiophores divergent, and cardinal process poorly preserved.

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Description : Gently convex shell, finely costellate with dichotomous branching ; length of shell 28 mm. and width 27 mm. measured along the hinge line. Brachiophores divergent, and cardinal process poorly preserved.

Remarks : The lack of diagnostic features prevents a definite assignment of these specimens. From general characters, they may represent a species of *Schuchertella*.

Order RHYNCHONELLIDA

Superfamily RHYNCHONELLACEA

Family RHYNCHOTREMATIDAE

Genus *Machaeraria* Cooper

MACHAERARIA sp.

(Plate 2, figs 5-12)

Material : Four specimens consisting of three complete internal moulds and a brachial impression from the Muth Quartzite (PUGD 1268-71).

Description : Small, subpentagonal in outline ; length less than width ; uniplicate, with well developed fold and sulcus ; costae strong, angular ; commissure serrate.

Dental plates short, not markedly divergent. Crural plates present ; tiny cardinal process connected to a relatively short median septum.

Remarks : The specimens seem to be closest to *Machaeraria formosa* (Hall) from the Lower Devonian of North America (Cooper, 1955, p. 55), though they show a somewhat more prominent median septum.

Order SPIRIFERIDA

Suborder ATRYPIDINA

Superfamily ATRYPACEA

Family ATRYPIDAE

Subfamily CARINATININAE

Genus *Plectatrypa* Schuchert & Cooper

PLECTATRYPA sp.

(Plate 1, figs 17-20)

Material : One external mould of both valves from the Muth Quartzite (PUGD 1272).

Description : Subequally biconvex, costate with dorsal fold and ventral sulcus ; costae bifurcate anteriorly ; growth lines prominent especially across costae ; beak incurved ; greatest width of shell 15 mm. midway from hinge line to anterior margin ; internal features unknown.

Remarks : Although somewhat poorly preserved, the specimen resembles in external appearance *Plectatrypa imbricata* (Sowerby) from the Silurian of Gotland (Schuchert and Cooper, 1930, p. 278), except that it is proportionally longer and thinner. According to Boucot, Johnson and Staton (1964), *Plectatrypa* ranges from Ashgillian to Gedinnian.

Suborder ATHYRIDIDINA

Superfamily ATHYRIDACEA

Family MERISTELLIDAE

Genus *Meristina* Hall

? MERISTINA sp.

(Plate 2, figs 13-15)

Material : External mould of one complete shell from the Muth Quartzite (PUGD 1273).

Description : Medium sized, smooth, biconvex, subpentagonal ; gentle dorsal fold and ventral sulcus. Greatest width posterior to anterior margin, measuring 18 mm. Internal features unknown.

Remarks : In the absence of internal features, the specimen can only be tentatively assigned to the genus *Meristina*. Another specimen (PUGD 1274 ;

Remarks : The lack of diagnostic features prevents a definite assignment of these specimens. From general characters, they may represent a species of *Schuchertella*.

Order RHYNCHONELLIDA
Superfamily RHYNCHONELLACEA
Family RHYNCHOTREMATIDAE
Genus *Machaeraria* Cooper
MACHAERARIA sp.
(Plate 2, figs 5-12)

Material : Four specimens consisting of three complete internal moulds and a brachial impression from the Muth Quartzite (PUGD 1268-71).

Description : Small, subpentagonal in outline ; length less than width ; uniplicate, with well developed fold and sulcus ; costae strong, angular ; commissure serrate.

Dental plates short, not markedly divergent. Crural plates present ; tiny cardinal process connected to a relatively short median septum.

Remarks : The specimens seem to be closest to *Machaeraria formosa* (Hall) from the Lower Devonian of North America (Cooper, 1955, p. 55), though they show a somewhat more prominent median septum.

Order SPIRIFERIDA
Suborder ATRYPIDINA
Superfamily ATRYPACEA
Family ATRYPIDAE
Subfamily CARINATININAE
Genus *Plectatrypa* Schuchert & Cooper
PLECTATRYPA sp.
(Plate 1, figs 17-20)

Material : One external mould of both valves from the Muth Quartzite (PUGD 1272).

Description : Subequally biconvex, costate with dorsal fold and ventral sulcus ; costae bifurcate anteriorly ; growth lines prominent especially across costae ; beak incurved ; greatest width of shell 15 mm. midway from hinge line to anterior margin ; internal features unknown.

Remarks : Although somewhat poorly preserved, the specimen resembles in external appearance *Plectatrypa imbricata* (Sowerby) from the Silurian of Gotland (Schuchert and Cooper, 1930, p. 278), except that it is proportionally longer and thinner. According to Boucot, Johnson and Staton (1964), *Plectatrypa* ranges from Ashgillian to Gedinnian.

Suborder ATHYRIDIDINA
Superfamily ATHYRIDACEA
Family MERISTELLIDAE
Genus *Meristina* Hall
? MERISTINA sp.
(Plate 2, figs 13-15)

Material : External mould of one complete shell from the Muth Quartzite (PUGD 1273).

Description : Medium sized, smooth, biconvex, subpentagonal ; gentle dorsal fold and ventral sulcus. Greatest width posterior to anterior margin, measuring 18 mm. Internal features unknown.

Remarks : In the absence of internal features, the specimen can only be tentatively assigned to the genus *Meristina*. Another specimen (PUGD 1274 ;

Plate 2, fig. 16) from the Muth Quartzite is about the same size, but lacks a fold and sulcus. It possibly belongs to the same family.

Family ATHYRIDIDAE

Subfamily ATHYRIDINAE

Genus *Athyris* McCoy

ATHYRIS aff. SPIRIFEROIDES (Eaton)

(Plate 2, figs 17-19)

Material : One external mould of a complete shell from the Muth Quartzite locality (PUGD 1275).

Description : Subequally biconvex, transverse, subcircular shell with a shallow ventral sulcus and dorsal fold. Greatest width midway between umbo and anterior margin, measuring 37 mm.; concentric growth lines. Internal features not known.

Remarks : The Kashmir shell is similar to larger specimens of *Athyris spiriferoides* from the Hamilton Beds of Eighteen Mile Creek, New York, in the Sydney University Geology Department reference collection (USGD 1500), but seems to be proportionally slightly thicker.

ATHYRIS sp.

(Plate 2, figs 20-22)

Material : External mould of one complete shell from the Muth Quartzite (PUGD 1276).

Description : Shell small, biconvex, subtrapezoidal ; shallow ventral sulcus and dorsal fold ; fine concentric growth lines ; greatest width 12 mm., a little anterior to the midline ; apical angle 88°. Internal features unknown.

Remarks : The specimen seems to be comparable with *Athyris concentrica* (von Buch) from the European and Asian Devonian, although smaller in size.

Suborder SPIRIFERIDINA

Superfamily SUESSIACEA

Family CYRTINIDAE

Genus *Cyrtina* Davidson

CYRTINA aff. HETEROCLITA (Defrance)

(Plate 2, figs 23-25)

Material : One small, virtually complete shell from the Muth Quartzite locality (PUGD 1277).

Description : Small, subpyramidal, spiriferoid ; relatively large, gently incurved triangular area with convex pseudodeltidium and foramen near apex ; faint longitudinal and transverse striations on interareas ; hinge line straight ; greatest width of shell 12 mm. measured a little anterior to hinge line ; weakly developed plications on lateral slopes ; fold raised, and sulcus depressed and rounded ; faint concentric growth lamellae observed in sulcus.

Remarks : The specimen differs from *Cyrtina heteroclita* in being somewhat smaller and having weakly developed plications. *C. heteroclita* is a moderately common Middle Devonian species in Europe and Asia. According to Talent (1963, p. 28), it ranges from Middle Siegenian to Givetian.

Acknowledgements

We wish to thank Professor M. R. Sahni for his assistance on various occasions during the course of this work ; and for the hospitality he extended to one of us (B. D. W.) during a visit to India in September-October, 1964. We also thank Dr. J. A. Talent for his helpful comments on the *Salopina* group. The photographs are the work of Mr. G. Z. Foldvary, Department of Geology and Geophysics, University of Sydney.

Plate 2, fig. 16) from the Muth Quartzite is about the same size, but lacks a fold and sulcus. It possibly belongs to the same family.

Family ATHYRIDIDAE

Subfamily ATHYRIDINAE

Genus *Athyris* McCoy

ATHYRIS aff. SPIRIFEROIDES (Eaton)

(Plate 2, figs 17-19)

Material : One external mould of a complete shell from the Muth Quartzite locality (PUGD 1275).

Description : Subequally biconvex, transverse, subcircular shell with a shallow ventral sulcus and dorsal fold. Greatest width midway between umbo and anterior margin, measuring 37 mm.; concentric growth lines. Internal features not known.

Remarks : The Kashmir shell is similar to larger specimens of *Athyris spiriferoides* from the Hamilton Beds of Eighteen Mile Creek, New York, in the Sydney University Geology Department reference collection (USGD 1500), but seems to be proportionally slightly thicker.

ATHYRIS sp.

(Plate 2, figs 20-22)

Material : External mould of one complete shell from the Muth Quartzite (PUGD 1276).

Description : Shell small, biconvex, subtrapezoidal ; shallow ventral sulcus and dorsal fold ; fine concentric growth lines ; greatest width 12 mm., a little anterior to the midline ; apical angle 88°. Internal features unknown.

Remarks : The specimen seems to be comparable with *Athyris concentrica* (von Buch) from the European and Asian Devonian, although smaller in size.

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References

Berry, W. B. M., and Gupta, V. J., 1966.—Monograptids from the Kashmir Himalayas. *Jour. Paleont.*, 40 : 1338–44.

Biernat, G., 1959.—Middle Devonian Orthoidea of the Holy Cross Mountains and their Ontogeny. *Palaeont. polon.*, 10 : 1–78.

Boucot, A. J., Johnson, J. G., and Staton, R. D., 1964.—On Some Atrypoid, Retzioid, and Athyridoid Brachiopoda. *Jour. Paleont.*, 38 : 805–22.

————, ————, and Walmsley, V. G., 1965.—Revision of the Rhipidomellidae (Brachiopoda) and the Affinities of *Mendacella* and *Dalejina*. *Jour. Paleont.*, 39 : 331–40.

Busch, D. A., 1941.—An ontogenetic study of some rugose corals from the Hamilton of Western New York. *Jour. Paleont.*, 15 : 392–411.

Cooper, G. A., 1955.—New genera of Middle Paleozoic Brachiopods. *Jour. Paleont.*, 29 : 45–63.

Fedorowski, J., 1965.—Lindstroemiidae and Amplexocariniidae (Tetracoralla) from the Middle Devonian of Skaly, Holy Cross Mountains, Poland. *Acta palaeont. polon.*, 10 : 335–64.

Gupta, V. J., and Denison, R. H., 1966.—Devonian fishes from Kashmir, India. *Nature*, 211 : 177–8.

Hill, D., and Jones, O. A., 1940.—The corals of the Garra Beds, Molong district, New South Wales. *Jour. Proc. roy. Soc. N.S.W.*, 74 : 175–208.

Hills, E. S., 1958.—A brief review of Australian fossil vertebrates, 86–107. In T. S. Westoll, edit., *Studies on Fossil Vertebrates*, xii+263 pp. Athlone Press, Univ. London.

Imbrie, J., 1959.—Brachiopods of the Traverse Group (Devonian) of Michigan. Part 1. Dalmanellacea, Pentameracea, Strophomenacea, Orthotetacea, Chonetacea and Productacea. *Bull. Amer. Mus. nat. Hist.*, 116 (4) : 345–410.

Jones, O. A., and Hill, D., 1940.—The Heliolitidae of Australia, with a discussion of the morphology and systematic position of the family. *Proc. roy. Soc. Queensland*, 51 : 183–215.

Lecompte, M., 1939.—Les Tabulés du Dévonien moyen et supérieur bord sud du Bassin de Dinant. *Mém. Mus. Hist. nat. Belg.*, 90 : 1–229.

Middlemiss, C. S., 1910.—A revision of Silurian-Trias sequence in Kashmir. *Rec. geol. Surv. India*, 40 (3), 206–60.

Pascoe, E. H., 1959.—" A Manual of the Geology of India and Burma." Vol. II. 3rd Edit. xxii, 485–1343 pp. Calcutta.

Reed, F. R. C., 1912.—Silurian fossils from Kashmir. *Rec. geol. Surv. India*, 42 (1) : 16–33.

Sahni, M. R., and Gupta, V. J., 1964.—Graptolites from the Kashmir Himalayas, also a note on the discovery of fossils in the Muth Quartzite. *Nature*, 204 : 1081–2.

Schuchert, C., and Cooper, G. A., 1930.—Upper Ordovician and Lower Devonian stratigraphy and paleontology of Percé, Quebec ; Part 2, New species from the Upper Ordovician of Percé. *Amer. Jour. Sci.*, ser. 5, 20 : 265–88.

Struve, W., 1965.—Beiträge zur Kenntnis devonischer Brachiopoden. 11. *Schizophoria striatula* und *Schizophoria excisa* in ihrer ursprünglichen Bedeutung. *Senck. leth.*, 46 : 193–215.

Stumm, E. C., 1964.—Silurian and Devonian corals of the Falls of the Ohio. *Mem. geol. Soc. Amer.*, 93 : 1–184.

Sutherland, P. K., 1965.—Rugose corals of the Henryhouse Formation (Silurian) in Oklahoma. *Bull. Okla. geol. Surv.*, 109 : 1–92.

Talent, J. A., 1963.—The Devonian of the Mitchell and Wentworth rivers. *Mem. geol. Surv. Victoria*, 24 : 1–118.

Walmsley, V. G., 1965.—*Isorthis* and *Salopina* (Brachiopoda) in the Ludlovian of the Welsh Borderland. *Palaeontology*, 8 : 454–77.

EXPLANATION OF PLATES

Plate viii

Coral specimens figured 1–9 from the Naubug Beds, and the brachiopod specimens figured 10–20 from the Muth Quartzite. All figured specimens $\times 1\frac{1}{3}$ unless otherwise stated.
Figs 1–2. *Stewartophyllum* sp. 1, PUGD 1250, $\times 2\frac{2}{3}$, transverse section 11 mm. above the base, showing well-developed fossulae. 2, PUGD 1250, $\times 2\frac{2}{3}$, transverse section 6 mm. above the base. Figs 3–4. *? Stereolasma* sp. 3, PUGD 1252, side view of internal mould. 4, PUGD 1251, oblique-side view of corallum. Figs 5–7. *? Heliolites* sp. 5, PUGD 1256, view of calicular surface. 6–7, PUGD 1256, $\times 4$, transverse and longitudinal sections. Figs 8–9. *Favosites gothlandicus* Lamarck forma *forbesi* Milne-Edwards and Haime. 8, PUGD 1257, view of outer surface. 9, PUGD 1257, $\times 2\frac{2}{3}$, oblique section. Figs 10–12. *Schizophoria* cf. *striatula* (Schlotheim). 10–12, PUGD 1264, pedicle, brachial and side views. Figs 13–16. *Salopina* sp. 13, PUGD 1259, view of internal mould of pedicle valve. 14, PUGD 1260, view of internal mould of pedicle valve. 15, PUGD 1261, view of internal mould of pedicle valve. 16, PUGD 1262, view of internal mould of brachial valve. Figs 17–20. *Plectatrypa* sp. 17–20, PUGD 1272, brachial, pedicle, side and posterior views.

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Berry, W. B. M., and Gupta, V. J., 1966.—Monograptids from the Kashmir Himalayas. *Jour. Paleont.*, 40 : 1338–44.

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PLATE IX

All figured specimens ×1⅛; from the Muth Quartzite locality.

Figs 1–2. *? Rhipidomella* sp. 1–2, PUGD 1265, pedicle and side views. Figs 3–4. ? Davidsoniacea gen. indet. 3. PUGD 1267, external mould of ?brachial valve. 4, PUGD 1266, internal mould of brachial valve. Figs 5–12. *Machaeraria* sp. 5–8, PUGD 1268, pedicle, brachial, posterior and anterior views. 9–12, PUGD 1269, pedicle, brachial, posterior and anterior views. Figs 13–16. *? Meristina* sp. 13–15, PUGD 1273, brachial, pedicle and side views. 16, PUGD 1274, brachial view. Figs 17–19. *Athyris* aff. *spiriferoides* (Eaton). 17–19, PUGD 1275, brachial, pedicle and side views. Figs 20–22. *Athyris* sp. 20–22, PUGD 1276, brachial, pedicle and side views. Figs 23–25. *Cyrtina* aff. *heteroclita* (Defrance). 23–25, PUGD 1277, brachial, pedicle and side views.

PLATE IX

All figured specimens $\times 1\frac{1}{3}$; from the Muth Quartzite locality.

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